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JOSEPH A. WILLIAMS, OF CLEVELAND, OHIO.

## EXPLOSIVE-ENGINE.

No. 811,809.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, JOSEPH A. WILLIAMS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Explosive-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of this invention is to provide an explosive-engine which while being simple in construction shall be economical in use and regular and certain in its action. I accomplish these results by providing a separable combustion-chamber and arranging a scavenging charge of compressed air which flows from the crank-chamber through the combustion-chamber after the firing and entirely clears out the combustion-chamber. This insures certainty in action of the engine and increases the efficiency and economy by preventing contamination of the fresh charge.

My invention may be summarized as consisting of the means employed to attain the above ends, as hereinafter more fully explained and as definitely set out in the claims.

In the drawings, Figure 1 is a longitudinal central section through the cylinder and valve-chambers of my engine. Fig. 2 is a top view thereof. Fig. 3 is a side elevation of the engine at right angles to Fig. 1, and Fig. 4 is a section of the upper part of the engine substantially on the line 4-4 of Fig. 2.

The same letters of reference designate the same part of each figure.

Referring to the parts by letters, A represents the cylinder of the engine. In this cylinder slides a reciprocating trunk-piston B, and the connecting-rod C connects the piston with the crank *i* in the chamber *a*, which is closed about the lower end of the cylinder. A water-jacket *a'* is shown around the upper portion of the cylinder. At the upper end of the cylinder, above the piston, is an extension or hood D, which, as shown, is a separate part secured to the cylinder. This hood and the plate *d* held in place thereby act as a head for the cylinder. Within the head is a small space *d'*, which constitutes the admission-chamber. Air and gas are sucked into the same at the proper time through a suitable opening *d'*. The most of the space between the plate *d* and the upper end of the hood is devoted to a series of combustion-

chambers. In the drawings two combustion-chambers *d*<sup>3</sup> *d*<sup>4</sup> are shown, being separated from each other by the partition *d*<sup>5</sup>.

E represents a bonnet, which is shown as secured to the side of a hood D and carries an exhaust-chamber *e*, which communicates with the exhaust-pipe through the opening *e*<sup>3</sup> and with the lowermost combustion-chamber through a passage-way *e'*.

The valves are all of the puppet type, being held to their seats by springs *f*<sup>6</sup> and opened positively by cam-levers. F is the admission-valve. F' and F<sup>2</sup> are double seat-valves controlling the combustion-chambers. F<sup>3</sup> is a valve controlling the scavenging charge, as hereinafter explained, and F<sup>4</sup> is the exhaust-valve. The stems of these valves have heads *f*, *f'*, *f*<sup>3</sup>, and *f*<sup>4</sup>, respectively, which are adapted to be engaged and depressed by the forward ends of levers G, G', G<sup>3</sup>, and G<sup>4</sup>. These levers are all operated by cams suitably placed on a cam-shaft H, which receives motion from the crank-shaft. The gearing shown between the cam-shaft and the crank-shaft consists of a bevel-gear *h* on the end of the cam-shaft, a meshing gear *j* on a lay-shaft J, the lower end of which carries the bevel-gear *j'*, meshing with the bevel-gear *i*<sup>2</sup> on the crank-shaft I. This mechanism provides means for positively opening the valves as desired, according to the adjustment of the cams on the cam-shaft H, as will be readily understood. Fig. 1 shows the piston in the position at the end of the compression-stroke, the charge being fully compressed into the combustion-chamber ready for firing.

The speed of the engine is regulated by governing in the manner hereinafter explained the amount of opening of the admission-valve F. To insure the proper compression of the mixture with its varying amount, I vary the combustion-chambers. As shown, there are two parts to the combustion-chambers, and the valve F<sup>3</sup> operates, as hereinafter explained, to shut off or leave connected the upper chamber, as desired. If less than one-half of the full charge is drawn, the valve F<sup>3</sup> is seated during the compression and firing strokes, thus restricting the combustion-chamber to the lower compartment *d*<sup>3</sup>. If, on the other hand, more than one-half of the full charge is drawn in, then the valve F<sup>3</sup> does not seat and both chambers *d*<sup>3</sup> and *d*<sup>4</sup> are used as combustion-chambers. The two